

CLAIMS

1. A data recording method for recording data as edge position information, including marks and spaces of multiple different lengths, on a storage medium by irradiating the storage medium with a pulsed energy beam, the method comprising the steps of:

(A) generating a write code sequence based on the data to be recorded;

(B) determining a write pulse waveform, defining the power modulation of the energy beam, according to the lengths of respective codes included in the write code sequence; and

(C) modulating the power of the energy beam based on the write pulse waveform,

wherein if the shortest code length of the write code sequence is n (which is an integer equal to or greater than one), the step (B) includes assigning a write pulse waveform that has only one write pulse to recording mark making periods corresponding to codes with code lengths x of n , $n+1$ and $n+2$, and a write pulse waveform that has multiple write pulses

Pw to recording mark making periods corresponding to codes with code lengths x of n+3 or more, respectively.

2. The data recording method of claim 1, wherein if the
5 shortest code length of the write code sequence is n (which is an integer equal to or greater than one), the step (B) includes classifying the code lengths x into at least four lengths including n, n+1, n+2 and n+3 or more, and

wherein as to two codes, which have code lengths m and m
10 + 1, respectively, and which have the same number of write pulses Pw in the recording mark making period of their write pulse waveforms, the step (B) includes determining the write pulse waveforms so as to satisfy the inequality:

(write pulse width of code length m) \leq (write pulse width
15 of code length m+1)

where the "write pulse width of code length m" is the width of an arbitrary Kth write pulse period included in the recording mark making period corresponding to the code length m and the
"write pulse width of code length m+1" is the width of the
20 Kth write pulse period included in the recording mark making

period corresponding to the code length $m+1$.

3. The data recording method of claim 1, wherein as to two codes, which have code lengths m and $m+1$, respectively, and which have the same number of write pulses P_w and the same number of periods with a bottom power level P_b between two write pulses P_w in the recording mark making period of their write pulse waveforms, the step (B) includes determining the write pulse waveforms so as to satisfy the inequality:

$$(10) \quad (\text{pulse width of code length } m) \leq (\text{pulse width of code length } m+1)$$

where the "pulse width of code length m " is the width of an arbitrary K th period with the bottom power level P_b included in the recording mark making period corresponding to the code length m and the "pulse width of code length $m+1$ " is the width of the K th period with the bottom power level P_b included in the recording mark making period corresponding to the code length $m+1$.

20 4. The data recording method of claim 1, wherein the

write pulse waveform in the recording mark making period corresponding to codes with code lengths x of $n+3$ or more includes write pulses, of which the number is equal to the quotient obtained by dividing $(x-1)$ by two.

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5. The data recording method of claim 1, wherein in the recording mark making period corresponding to codes with code lengths x of $n+3$ or more, the length of a period in which the write pulse waveform has an erasure power level P_e is set to
10 be at least equal to $1/T_w$.

6. The data recording method of one of claims 1 to 5, wherein in each said recording mark making period, the length of a period in which the write pulse waveform has the bottom
15 power level P_b is set to be at least equal to $1/T_w$.

7. The data recording method of one of claims 1 to 6, wherein in each said recording mark making period, the length of a period in which the write pulse waveform has a cooling
20 power level P_c is set to be at least equal to $1/T_w$.

8. The data recording method of one of claims 1 to 7,
wherein the start position of the first pulse, included in a
recording mark making period of the write pulse waveform, and
the end position of a cooling pulse, also included in the
5 recording mark making period, are shifted according to the
length x of a code associated with the recording mark making
period.

9. The data recording method of claim 8, wherein the
10 positions are shifted to at least four different degrees
corresponding to the code lengths x of n , $n+1$, $n+2$ and $n+3$
or more.

10. An apparatus for recording data as edge position
15 information, including marks and spaces of multiple different
lengths, on a storage medium by irradiating the storage
medium with a pulsed energy beam, the apparatus comprising:

laser driving means for modulating the power of the
energy beam;

20 coding means for converting the data to be recorded on

the storage medium into a write code sequence; and

mark length classifying means for determining a write pulse waveform, defining the power modulation of the energy beam, according to the code lengths x of respective codes
5 included in the write code sequence,

wherein if the shortest code length of the write code sequence is n (which is an integer equal to or greater than one), the mark length classifying means assigns a write pulse waveform that has only one write pulse P_w to recording mark
10 making periods corresponding to codes with code lengths x of n , $n+1$ and $n+2$, and a write pulse waveform that has multiple write pulses P_w to recording mark making periods corresponding to codes with code lengths x of $n+3$ or more, respectively.

15 11. The apparatus of claim 10, wherein as to two codes, which have code lengths m and $m+1$, respectively, and which have the same number of write pulses P_w and the same number of periods with a bottom power level P_b between two write pulses P_w in the recording mark making period of their write pulse
20 waveforms, the write pulse waveforms are determined so as to

satisfy the inequality:

$$(\text{pulse width of code length } m) \leq (\text{pulse width of code length } m+1)$$

where the "pulse width of code length m " is an arbitrary K th
5 period with the bottom power level included in the recording
mark making period corresponding to the code length m and the
"pulse width of code length $m+1$ " is the K th period with the
bottom power level included in the recording mark making
period corresponding to the code length $m+1$.

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12. The apparatus of claim 11, wherein if the shortest
code length of the write code sequence is n (which is an
integer equal to or greater than one), the code lengths x are
classified into at least four lengths including n , $n+1$, $n+2$
15 and $n+3$ or more, and

wherein as to two codes, which have code lengths m and m
 $+1$, respectively, and which have the same number of write
pulses P_w in the recording mark making period of their write
pulse waveforms, the write pulse waveforms are determined so
20 as to satisfy the inequality:

(write pulse width of code length m) \leq (write pulse width
of code length $m+1$)

where the "write pulse width of code length m " is the width of
an arbitrary K th write pulse period included in the recording
5 mark making period corresponding to the code length m and the
"write pulse width of code length $m+1$ " is the width of the
 K th write pulse period included in the recording mark making
period corresponding to the code length $m+1$.

10 13. The apparatus of claim 11, wherein as to two codes,
which have code lengths m and $m+1$, respectively, and which
have the same number of write pulses P_w and the same number of
periods with a bottom power level P_b between two write pulses
 P_w in the recording mark making period of their write pulse
15 waveforms, the write pulse waveforms are determined so as to
satisfy the inequality:

(pulse width of code length m) \leq (pulse width of code
length $m+1$)

where the "pulse width of code length m " is the width of an
20 arbitrary K th period with the bottom power level P_b included

in the recording mark making period corresponding to the code length m and the "pulse width of code length $m+1$ " is the width of the K th period with the bottom power level P_b included in the recording mark making period corresponding to
5 the code length $m+1$.

14. The apparatus of claim 11, wherein the write pulse waveform in the recording mark making periods corresponding to codes with code lengths x of $n+3$ or more is determined so as
10 to include a number of write pulses that is equal to the quotient obtained by dividing $(x-1)$ by two.

15. The apparatus of claim 11, wherein the write pulse waveforms are determined such that every interval between
15 trailing and leading edges of a fundamental waveform of a laser pulse in the mark making periods becomes at least equal to a detection window width T_w .

16. The apparatus of claim 11, comprising pulse shifting
20 means for shifting the start position of the first pulse,

included in a recording mark making period of the write pulse waveform, and the end position of a cooling pulse, also included in the write pulse waveform, according to the length x of a code associated with the recording mark making period.

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17. The apparatus of claim 16, comprising write compensating means for shifting the positions to at least four different degrees corresponding to the code lengths x of n , $n+1$, $n+2$ and $n+3$ or more.